Smart Door Access Control System with Facial Recognition and Notification

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In partial fulfilment of the requirement for the degree of Bachelor of Science (Engg.) in Information and Communication Technology under the Course Code of ICT-4000, Course Title: Thesis/Project, a report has been submitted.

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May, 2024

DECLARATION

This is to certify that the project work entitled **"Smart Door Access Control System with Facial Recognition and Notification"** has been carried out by Md. Mehedi Hasan and Tazul Islam in the Department of Information and Communication Technology, Santosh, Tangail-1902, Bangladesh. I evidence that, the thesis work or any part of this work has not submitted anywhere for the award of any degree or diploma. The information has allowed for this document accurate and valid to best of our cognition.

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APPROVAL

This is to certify that the project work submitted by Md. Mehedi Hasan (IT-19034) and Tazul Islam (IT-19049) entitled ***"Smart Door Access Control Sys- tem with Facial Recognition and Notification"*** has been approved by the examination committee for the partial fulfillment of the requirements for the degree of Bachelor of Science (Engg.) in the Department of Information and Communication Technology, Mawlana Bhashani Science and Technology University, Santosh, Tangail-1902, Bangladesh in 5th, 6th and 7th May, 2024.

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Abstract

In the era of the Internet of Things (IoT), our world is becoming smarter and more connected. IoT is about linking everyday objects to the internet, making them responsive and intelligent. This innovation has given birth to the Door Lock System using mobile apps via the internet. The demand for enhanced security and convenience drives this project. People want more control over their homes, and IoT delivers precisely that. It enables the creation of systems that understand and respond to their surroundings, transforming our lives for the better. In today's world, security and convenience are paramount concerns for homeowners. This system offers a seamless blend of both, allowing you to monitor and control access to your home from anywhere using a simple mobile app interface. Imagine receiving a live video stream when someone approaches your door, and with a tap on your phone, you can grant or deny access, all while receiving instant notifications of these events. The core of this system lies in a blend of sophisticated software and hardware technologies. We delve into the intricacies of Arduino IDE, Python programming, Twilio API for communication, and the IP Webcam app for video streaming. On the hardware side, components like the Arduino Mega 2560, NodeMCU (ESP8266), relay modules and electric locks work in harmony to create a reliable and robust security infrastructure.

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Chapter 1

INTRODUCTION

1.1 Introduction

In the context of the Fourth Industrial Revolution (4IR), which is characterized by the integration of digital technologies, data analytics, artificial intelligence, and automation, the need for face recognition-based door systems becomes even more relevant. The 4IR introduces a complex digital landscape where data breaches and cyberattacks are prevalent. Face recognition systems provide a higher level of security compared to traditional methods, aligning with the increased need for robust security solutions in this era. A face recognition-based door system allows users to enter a building or space without touching any surfaces, reducing the risk of transmitting germs. Traditional access methods like keys, cards, or passwords can be lost, stolen, or shared. Face recognition provides a higher level of security as it is difficult to replicate or forge someone's facial features. This can help prevent unauthorized access and improve overall security. Face recognition is faster and more convenient than typing in passwords, scanning cards, or searching for keys. Users can be authenticated almost instantly just by looking at the camera. Therefore, A face recognition-based door lock system with notification is an advanced security system that utilizes facial recognition technology to grant access to authorized individuals. This system captures and analyzes the facial features of individuals approaching the door, comparing them with a pre-defined database of authorized users. Furthermore, this system sends real-time notifications to the owner's smartphone, providing updates on door activity.

1.2 Motivation of the Project

The motivation behind the Smart Door Access Control System with Facial Recognition and Notification project stems from several factors:

- **Security Reinvention:** With traditional security measures facing challenges like key duplication and unauthorized access, there's a growing need for innovative solutions. This project aims to reinvent door access control by incorporating facial recognition technology, enhancing security while ensuring convenience.
- **Convenience and Control:** In an era of digital connectivity, homeowners seek solutions that offer convenience and control at their fingertips. The project's integration with a

mobile app empowers users to monitor and manage access remotely, enhancing overall security posture.

- **Technology Integration:** By combining software technologies like Arduino IDE, Python, and Twilio API with hardware components such as Arduino Mega and NodeMCU, this project exemplifies the power of technology integration. It showcases how diverse technologies can converge to create a cohesive and effective solution.
- **Customizability and Scalability:** One size doesn't fit all in security solutions. The customizable nature of this system allows homeowners to tailor settings according to their preferences, making it adaptable to different environments and security requirements. Its scalability ensures that it can grow alongside evolving security needs.
- **Affordability and Accessibility:** While cutting-edge, the project emphasizes affordability and accessibility. It brings advanced security features within reach of a broader audience, promoting the adoption of smart security solutions across residential, commercial, and community settings.
- **Smart Home Integration:** As part of the larger smart home ecosystem, this project aligns with the trend of interconnected devices and automation. It seamlessly integrates with existing home automation systems, offering a holistic approach to modern living that prioritizes security without sacrificing convenience.
- **Future-Proofing Security:** With rapid technological advancements, future-proofing security systems is crucial. This project lays the groundwork for incorporating emerging technologies and updates, ensuring longevity and relevance in the face of evolving security challenges.

1.3 Purpose and Objectives

1.3.1 Purpose

The purpose of the "Smart Door Access Control System with Facial Recognition and Notification" project is to revolutionize home security through advanced technology. It aims to provide homeowners with a robust and convenient solution for managing door access remotely. Additionally, the project serves as an educational tool, offering insights into integrating software and hardware components while exploring the potentials of facial recognition systems and IoT principles. By showcasing the system's capabilities, the project contributes to promoting smart living environments and encourages innovation in the field of home security and automation.

1.3.2 Objective

- **System Design and Development:** Design and develop a smart door access control system that integrates facial recognition technology and notification alerts for real-time monitoring and access control.
- **Hardware Integration:** Integrate hardware components such as Arduino Mega 2560, NodeMCU (ESP8266), relay modules, and electric locks to create a functional and reliable system for door access control.

- **Software Integration and Programming:** Implement software solutions using Arduino IDE and Python programming to enable seamless communication between hardware components and the mobile/web application for access management.
- **Real-time Notification System:** Implement a real-time notification system that sends alerts to homeowners via SMS or mobile app notifications when a visitor approaches the door, providing instant access control options.
- **Mobile/Web Application Development:** Develop a user-friendly mobile or web application interface that allows homeowners to remotely monitor door access, view live video streams, and grant or deny access to visitors from anywhere.
- **Security and Privacy Measures:** Incorporate security protocols to safeguard user data, ensure secure communication channels between devices, and protect against unauthorized access attempts or tampering.
- **Customization and Scalability:** Design the system to be customizable, allowing users to configure settings such as access permissions, notification preferences, and integration with existing home automation systems. Ensure scalability to accommodate future upgrades or expansions.
- **Testing and Validation:** Conduct thorough testing and validation of the system to ensure functionality, accuracy in facial recognition, reliability in access control, and responsiveness in notification alerts under various scenarios and conditions.

The objectives include designing and developing the robot car, integrating sensors, implementing obstacle avoidance and line following algorithms, developing an Android application for remote control, exploring practical applications, serving as an educational tool, and promoting innovation in robotics technology.

1.4 Features

The Smart Door Access Control System with Facial Recognition and Notification Project includes several features.They are,

- **Real-time Notification Alerts:** Receive instant notification alerts via SMS or mobile app notifications when a visitor approaches the door, enabling quick decision-making and access control.
- **Remote Access Control:** Utilize a user-friendly mobile or web application interface to remotely monitor door access, grant or deny entry, and manage access permissions from anywhere.
- **Customizable Access Settings:** Configure personalized access settings such as scheduled access times, visitor permissions, and notification preferences to suit individual needs and preferences.
- **Intuitive User Interface:** Benefit from an intuitive and easy-to-use interface that simplifies the process of monitoring and managing access control settings, enhancing user experience and usability.

- **Scalability and Future-Proofing:** Design the system to be scalable, allowing for future upgrades, expansions, and integration with new technologies to adapt to evolving security needs and technological advancements.
- **Advanced Security Features:** Implement advanced security features such as encryption protocols, multi-factor authentication, and tamper detection to enhance overall security posture and prevent unauthorized access.
- **Advanced Security Features:** Maintain detailed access logs and activity records, providing a comprehensive overview of door access events and enhancing accountability and transparency.

Chapter 2

PROJECT DESCRIPTION

2.1 Project Perspective

The "Smart Door Access Control System with Facial Recognition and Notification" project presents a multifaceted perspective that encompasses various dimensions of technology, education, practicality, interaction, innovation, research, and user experience.

From a technological standpoint, the project represents a leap forward in home security systems by integrating cutting-edge technologies like facial recognition and real-time notifications. It showcases advancements in the realm of smart security solutions, highlighting the capabilities of modern technology to enhance safety and convenience in residential settings.

As an educational tool, the project offers a valuable learning experience for students, enthusiasts, and professionals interested in home automation and security. It provides a hands-on platform to gain practical knowledge in integrating hardware and software components, understanding IoT principles, and exploring the functionalities of facial recognition systems.

The practical applications of the system extend beyond residential homes to various environments such as apartment complexes, commercial buildings, and smart communities. By demonstrating its adaptability and scalability, the project underscores the relevance and potential of smart security solutions in real-world scenarios.

Human-robot interaction is a key aspect emphasized by the Android application control feature. This feature enhances user experience by providing a user-friendly interface for remote control, fostering seamless communication and collaboration between humans and the automated system.

Furthermore, the project encourages innovation and research within the field of home security and automation. It provides a platform for further advancements, experimentation with new technologies, and the development of novel solutions to address evolving security challenges.

2.2 Why did I choose This Project?

The decision to pursue the Smart Door Access Control System with Facial Recognition and Notification project is driven by several key factors, aligning with personal interests, goals, and motivations:

- **Interest in Security and Technology:** A strong interest in the intersection of security systems and technology motivates the choice of this project. Exploring cutting-edge technologies such as facial recognition, real-time notifications, and remote access control aligns with a passion for innovative solutions in home security.
- **Educational and Learning Opportunity:** The project presents a valuable learning opportunity across various disciplines such as electronics, software development, IoT integration, and security protocols. By engaging in this project, there is a chance to acquire new skills, deepen understanding in relevant fields, and enhance problem-solving abilities within the context of smart home automation.
- **Integration of Advanced Features:** The integration of advanced features like facial recognition and real-time notifications into a cohesive system offers an exciting challenge. The complexity and versatility of integrating these functionalities into a smart door access control system contribute to a desire for technical and creative exploration.
- **Desire for Innovation and Practical Application:** The project fosters innovation and creativity through the development of custom algorithms, hardware integration, and user interfaces. There is a drive to create practical solutions that address real-world security concerns while leveraging modern technological advancements.
- **Personal Interest and Fulfillment:** Beyond technical aspects, there is a personal interest and fulfillment associated with working on projects that contribute to improving daily life experiences. Building a smart door access control system that enhances security, convenience, and user experience resonates with personal values and aspirations within the realm of home automation and technology.

2.3 System Planning

System planning for the Smart Door Access Control System with Facial Recognition and Notification project involves strategic organization and outlining of crucial steps for successful implementation. Here's an overview of the system planning process tailored for this project:

- **Define Project Objectives:** Clearly define the project's objectives, including the desired functionalities such as facial recognition, real-time notification alerts, remote access control, and integration with existing home automation systems.
- Determine specific requirements such as facial recognition accuracy, notification response time, and compatibility with different mobile devices for the Android application.

- **Determine Hardware and Software Components:** Identify and list the required hardware components, including microcontrollers (Arduino Mega, NodeMCU), relay modules, electric locks, facial recognition modules/cameras, sensors (such as PIR sensors), and power sources.
- Select appropriate software components such as Arduino IDE for programming Arduino boards, Python for implementing the Twilio API and facial recognition algorithms, and Android Studio for developing the mobile application
- **Design the System Architecture:** Develop a comprehensive system architecture that outlines the interactions between hardware and software components.
- Define how facial recognition data will be captured and processed, how real-time notifications will be generated and sent to users, and how the Android application will communicate with the central control system.
- **Develop Algorithms and Logic:** Develop algorithms and logic for facial recognition, obstacle detection, real-time notification generation, access control decision-making, and communication protocols.
- Implement logic for facial feature extraction, comparison, and access authorization. Develop algorithms for obstacle detection using sensors and decision-making processes for access control.
- **Prototype and Testing:** Build a prototype of the smart door access control system based on the defined system architecture and component selection. Assemble hardware components, integrate software modules, and conduct initial testing to verify basic functionality and system interactions. Perform thorough testing to evaluate facial recognition accuracy, obstacle detection reliability, notification responsiveness, and overall system stability under different scenarios
- **System Integration and Optimization:** Integrate all hardware and software components into a unified system, ensuring compatibility and seamless communication. Optimize system performance by fine-tuning algorithms, adjusting sensor calibration, optimizing power consumption, and enhancing user interface responsiveness. Conduct comprehensive system testing to validate all functionalities, address any identified issues or bugs, and ensure the system meets performance requirements and user expectations

2.4 System Analysis

The System Analysis phase of the Smart Door Access Control System with Facial Recognition and Notification project focuses on the software's overall structure, nuances, and critical aspects such as package architecture, database design, data structure design, and user interface design. This phase is crucial as any flaws or oversights can lead to costly issues later in the development cycle.

The analysis and design phase is integral to the entire development cycle management process. It involves defining the necessary tiers for the software's architecture without explicitly outlining client-server technology. Instead, the emphasis is on structuring the

system's components effectively to ensure optimal performance, scalability, and user experience.

A key aspect of system analysis is understanding and defining the user interface (UI). The UI serves as the primary point of interaction between users and the system. It encompasses screen displays for navigation, data input forms, and report generation features. Designing an intuitive and user-friendly UI is paramount to enhancing user satisfaction and system usability.

2.5 Project Goals

Project Goals:

- Implement real-time notification alerts to provide homeowners with instant updates upon visitor interaction at the door.
- Develop a user-friendly mobile or web application interface that allows homeowners to remotely monitor and manage door access control settings.
- Design the system to seamlessly integrate with existing home automation setups, providing a comprehensive and interconnected smart home security solution
- Build a system that is scalable and adaptable to future upgrades or expansions, accommodating evolving security needs and technological advancements.
- Serve as an educational tool to engage users and enthusiasts in understanding the capabilities and potential of smart home security systems.

Chapter 3

Methodology and Requirement Analysis

3.1 Introduction

The "Smart Door Access Control System with Facial Recognition and Notification" project addresses the growing need for efficient and secure home automation solutions. Understanding user requirements and selecting appropriate technologies are key steps in creating a tailored automation system. This project focuses on installing hardware components like smart devices and sensors, alongside programming software for seamless functionality. By integrating advanced technologies with user-centric design, the project aims to enhance home security and convenience, catering to modern living environments.

This step involves installing and configuring the hardware components (smart devices, sensors, controllers) and programming the software (apps, interfaces, automation rules) to ensure proper functionality.

3.2 Procedure

The implementation of the Smart Door Access Control System with Facial Recognition and Notification project involves a structured procedure aimed at achieving seamless automation and enhanced security. The procedure of the project can divide into two parts.

- Connecting the hardware components with the corresponding microcontroller properly.
- Upload the code to give instruction to the microcontroller to control the devices.

3.3 User Requirement

User requirements for the Smart Door Access Control System with Facial Recognition and Notification encompass various aspects crucial to enhancing home security, convenience, and customization. Here are some common user requirements to consider:

- **Convenience and Control:**
  Users require the ability to control access to their home seamlessly, including granting or denying entry remotely. Integration with user-friendly interfaces such as mobile apps or web portals for effortless management of access control settings. Automation of access control tasks to simplify routine operations and enhance user convenience. [**?**] Automation of repetitive tasks and routines to enhance convenience and save time.
- **Security and Access Control:**
  Robust security features such as facial recognition technology for accurate and secure authentication of individuals. Secure access mechanisms including password protection, encryption techniques, and secure communication protocols to prevent unauthorized access. Real-time notification alerts to users upon visitor interaction, enhancing awareness and security monitoring.
- **Customization and Personalization:**
  Customizable access settings and permissions based on individual user preferences and scenarios. Personalization options for notifications, access schedules, and user-specific access controls. Flexibility to create and modify access rules, schedules, and security settings according to changing needs. [**?**]
- **Integration and Scalability:**
  Seamless integration with existing home automation systems and compatibility with a wide range of smart devices. Support for future expansions and integrations, allowing users to add new devices or functionalities without disruptions. Scalability to accommodate advancements in technology and emerging smart home standards, ensuring long-term usability and relevance.
- **Expandability and Scalability:**
  Ability to add and integrate new devices and functionalities as needed without major disruptions or complexities. Support for future technology advancements and compatibility with emerging smart home standards.

3.4 System Requirement

System requirements for the Smart Door Access Control System with Facial Recognition and Notification are vital to ensure its seamless operation and integration within a smart home environment. Here are the system requirements structured for this project:

- **Connectivity:** Reliable and secure network connectivity, preferably Wi-Fi or Ethernet, to establish communication between the central control unit and smart devices. Ensured signal coverage throughout the premises to maintain uninterrupted data transmission and control capabilities.

- **Centralized Control:**

  A centralized control unit or hub that acts as the nerve center of the home automation system, managing access control, facial recognition, notification alerts, and other connected devices. Compatibility with multiple smart devices and protocols, allowing for seamless integration and management through a unified interface or platform.

- **Scalability:**

  The system should support scalability by accommodating the addition of new devices or functionalities without compromising performance. Ability to handle a growing number of devices and users, ensuring the system remains efficient and responsive as the smart home ecosystem expands.

- **Flexibility and Customization:**

  Customization options for users to personalize access control settings, notification preferences, scheduling, and automation routines. Compatibility with diverse control interfaces including mobile apps, web portals, voice commands, and physical control panels, providing users with versatile control options.

- **Energy Efficiency:**

  Integration with energy monitoring features to track and manage energy usage, promoting energy efficiency and cost savings. Support for energy-efficient devices and sensors to align with eco-friendly practices and sustainability goals.

3.5 Used Platform/Tools

3.5.1 Hardware Tools

Smart Door Access Control Systems consist of various hardware components. Here are some common hardware tools used in systems:

– **Arduino Mega 2560:** The Arduino Mega 2560 is a microcontroller board based on the ATmega2560. It has 54 digital input/output pins (of which 15 can be used as PWM outputs), 16 analog inputs, 4 UARTs (hardware serial ports), a 16 MHz crystal oscillator, a USB connection, a power jack, an ICSP header, and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started. The Mega 2560 board is compatible with most shields designed for the Uno and the former boards Duemilanove or Diecimila.
In this project Arduino mega is used to control the rfid module, servo motor and liquid crystal display to control the lock system of home automation.

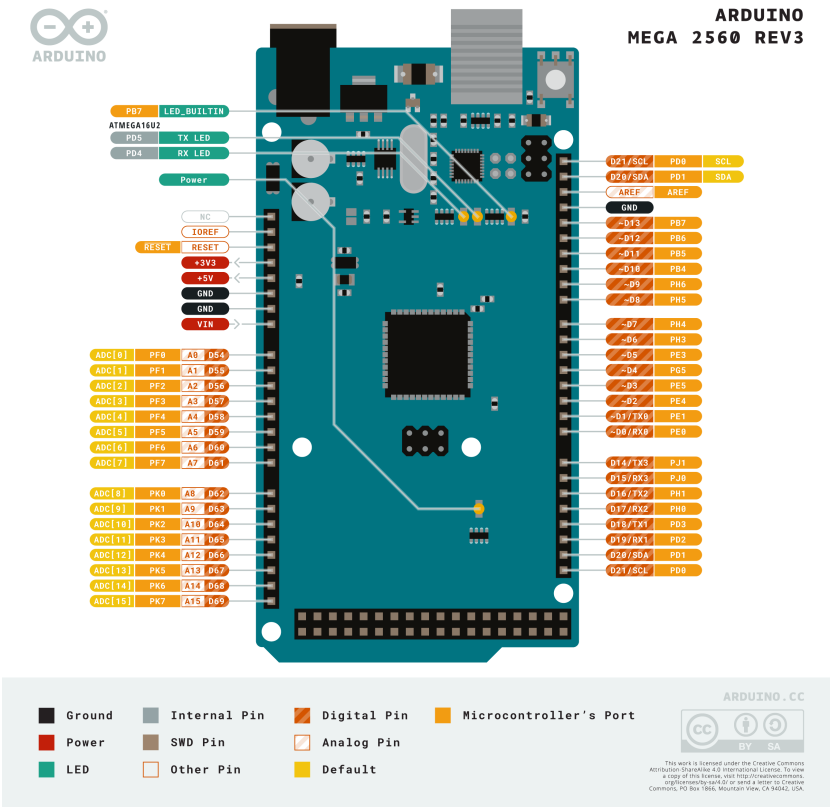

Figure 3.1: Arduino Mega 2560

– **NodeMCU (ESP8266):** The NodeMCU (Node MicroController Unit) is an open-source software and hardware development environment built around an inexpensive System-on-a-Chip (SoC) called the ESP8266. The ESP8266, designed and manufactured by Espressif Systems, contains the crucial elements of a computer: CPU, RAM, networking (WiFi), and even a modern operating system and SDK. That makes it an excellent choice for Internet of Things (IoT) projects of all kinds.However, as a chip, the ESP8266 is also hard to access and use. You must solder wires, with the appropriate analog voltage, to its pins for the simplest tasks such as powering it on or sending a keystroke to the "computer" on the chip. You also have to program it in low-level machine instructions that can be interpreted by the chip hardware. This level of integration is not a problem using the ESP8266 as an embedded controller chip in mass-produced electronics. It is a huge burden for hobbyists, hackers, or students who want to experiment with it in their own IoT projects.

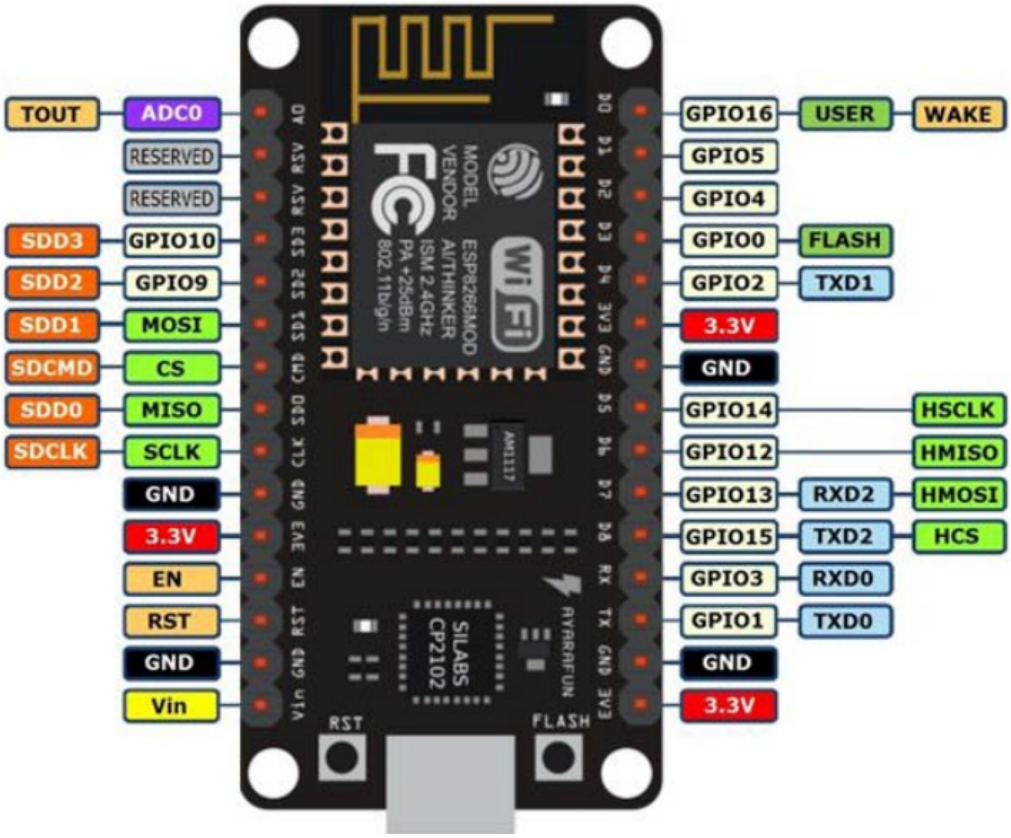

Figure 3.2: NodeMCU or ESP8266

– **Relay Module:** Relay modules are simply circuit boards that house one or more relays. They come in a variety of shapes and sizes, but are most commonly rectangular with 2, 4, or 8 relays mounted on them, sometimes even up to a 16 relays.A relay is an electrical switch that can be used to control devices and systems that use higher voltages. In the case of module relay, the mechanism is typically an electromagnet. Relay modules contain other components than the relay unit. These include indicator LEDs, protection diodes, transistors, resistors, and other parts.

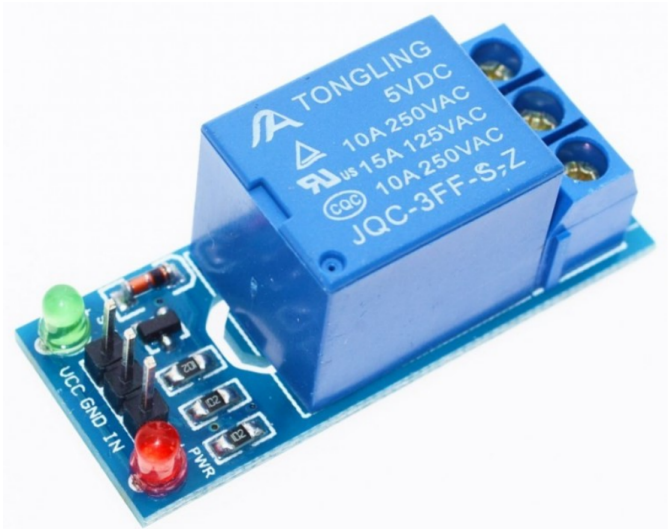

Figure 3.3: Relay Module

– **Jumper Wire:** A jumper wire is an electrical wire that has connector pins at each end, allowing them to be used to connect two points to each other without soldering. Jumper wire are typically with breadboards and other prototyping tools in order to make it easy to change a circuit as needed. Individual jumper wires are fitted by inserting their end connectors into the slots provided in a breadboard the header connected of a circuit board or piece of test equipment. Jumper wire are in three version:-male to male, male to female and female to male.

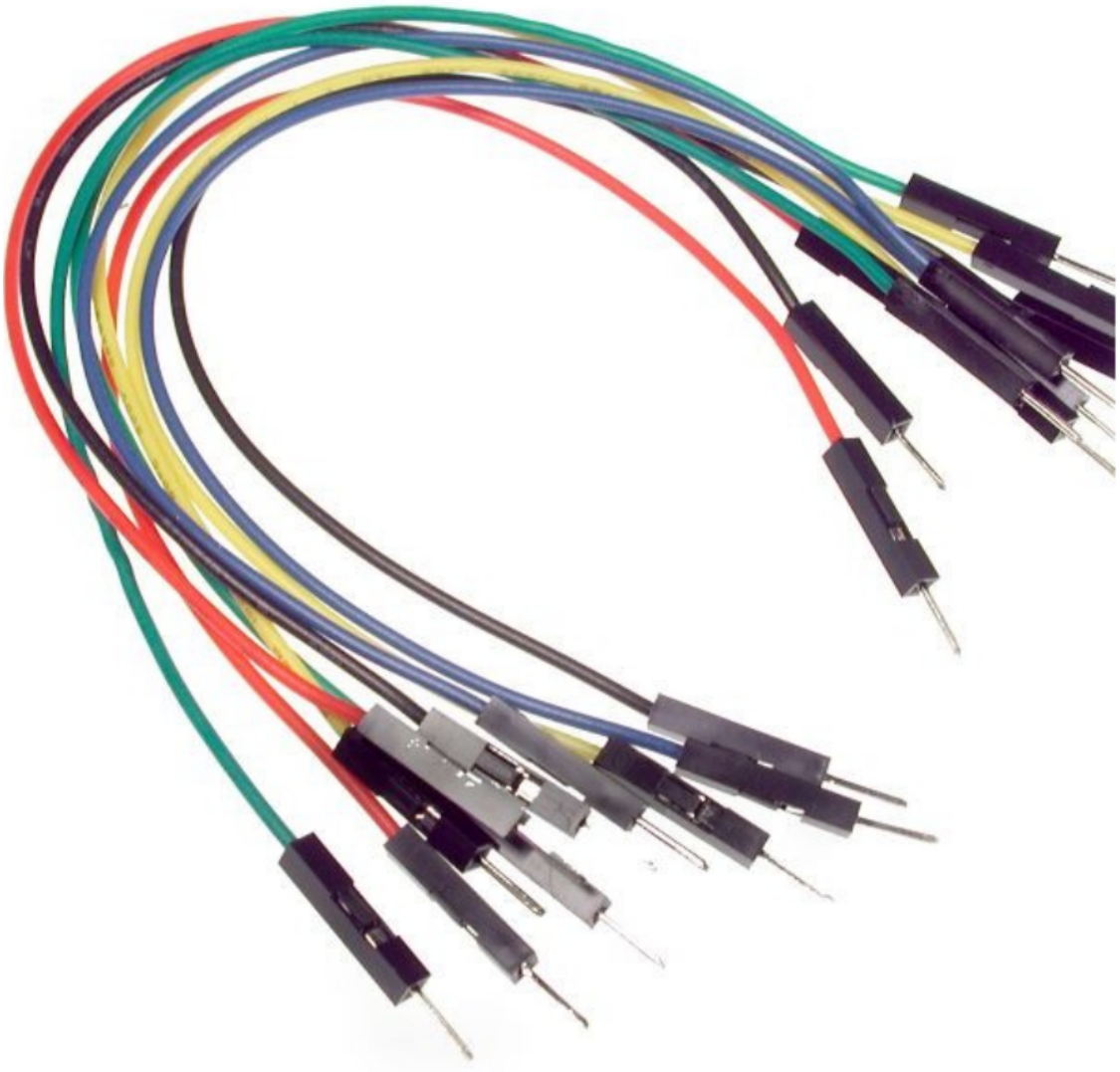

Figure 3.4: Jumper Wire

– **9V Battery:**The nine-volt battery, or 9-volt battery, is an electric battery that supplies a nominal voltage of 9 volts. Actual voltage measures 7.2 to 9.6 volts, depending on battery chemistry. Batteries of various sizes and capacities are manufactured; a very common size is known as PP3, introduced for early transistor radios.

Figure 3.5: 9V Battery

– **Solenoid electric lock:** Solenoid lock are basically electromagnets: they are made of a big coil of copper wire with an armature (a slug of metal) in the middle. When the coil is energized, the slug is pulled into the center of the coil. This makes the solenoid able to pull from one end. Normally the lock is active so you can't open the door because the solenoid slug is in the way. It does not use any power in this state. When 9-12VDC is applied, the slug pulls in so it doesn't stick out anymore and the door can be opened.

Figure 3.6: Solenoid electric lock

– **Switch:** A control is defined as an on-off switch when its function is to open or close an electrical circuit in a stable manner. If the closing or opening occurs in a non-stable or momentary manner, we are talking about a momentary on-off switch or push-button on-off switch, more briefly called on-off push-button.

Figure 3.7: 0/1 switch

3.5.2 Software tools

Software components play a crucial role in IoT (Internet of Things) systems, including Smart Door Access Control Systems. Here are the software components used in this project.

- **Arduino IDE:** The Arduino integrated development environment (IDE) is a cross-platform application (for Win- dows, Mac OS and Linux) that is written in the programming language java. It is used and uploads programs to Arduino compatible boards. Arduino IDE is an open source that is mainly used for writing and compiling code into the Ar- duino module. It is official software making code compilation so easy that even a common person with no prior technical knowledge can get their feet with the learning process. A different range of Arduino modules is available including Arduino Uno, Arduino mega, Arduino Nano, and many more. Each of them consists a microcontroller on the board that is actually programmed and accepts the information in the form of code. The IDE environment mainly contains two basic parts: Editor and compiler where the former is used for writing the required code and later is used for compiling and uploading the code into the given Arduino module.

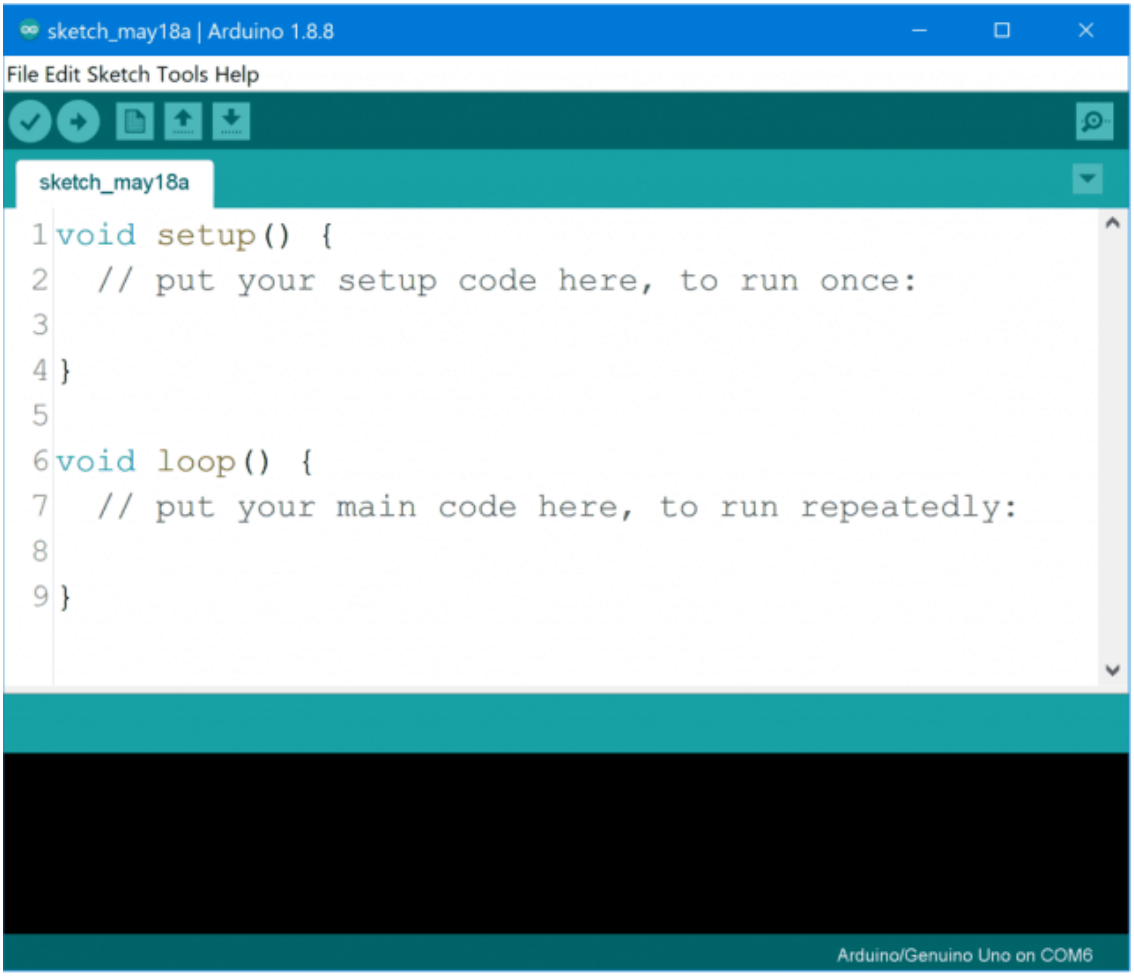

Figure 3.8: Arduino IDE

– **PyCharm IDE:** PyCharm, crafted by JetBrains, stands as a premier Integrated Development Environment (IDE) for Python, revolutionizing the coding experience. Boasting a rich suite of features, it empowers devel- opers with tools that amplify efficiency and enjoyment in Python development. At its core, PyCharm houses an intelligent code editor that goes beyond mere text input. It offers code completion, real-time analysis, and automated refactoring, essentially acting as a coding companion that suggests improvements and identifies errors in real-time. Navigation through complex projects becomes effortless with PyCharm's robust code navigation features. Developers can seamlessly traverse files, classes, and methods, elevating productivity and minimizing code-search time. The IDE incorporates a fully-integrated debugger, invaluable for troubleshooting and refining code. Supporting both local and remote debugging, it enables step-by-step code analysis, breakpoint setting, and variable inspection.

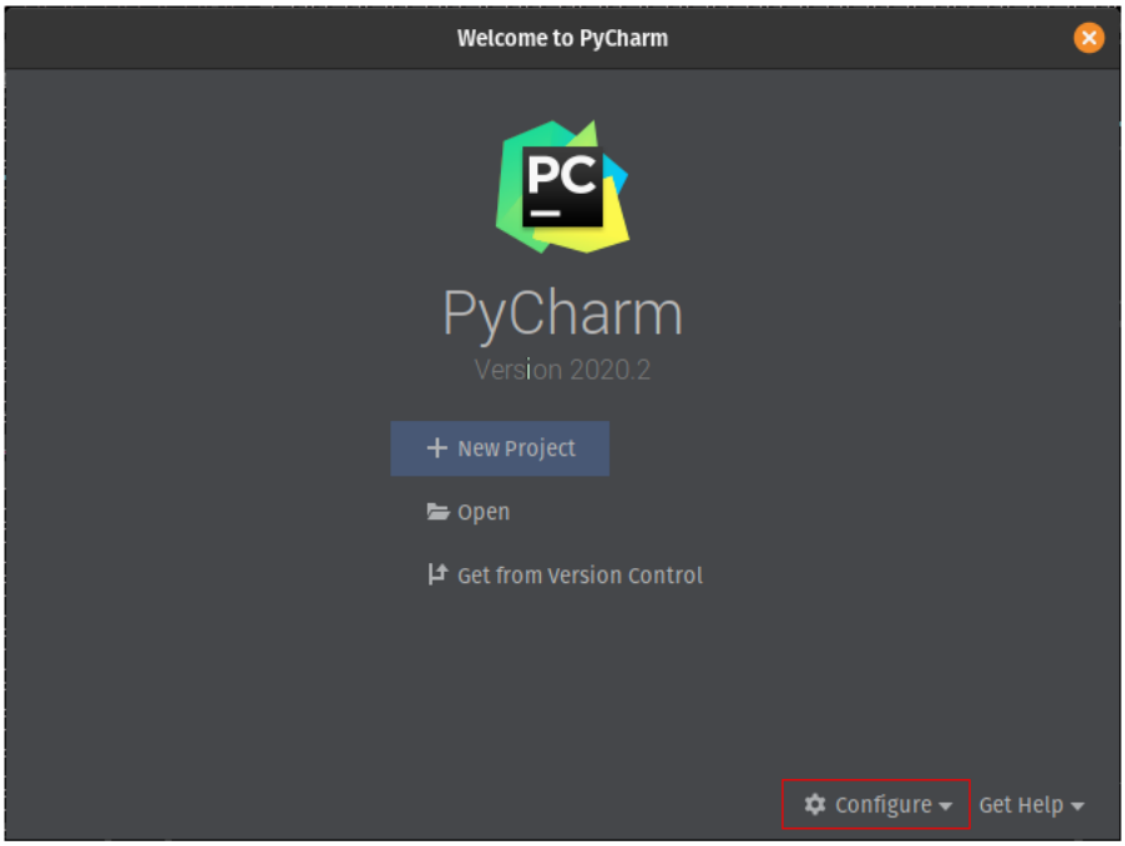

Figure 3.9: PyCharm IDE

– **IP Webcam:** The IP Webcam app revolutionizes smartphone utility by transforming Android devices into remote cameras and surveillance systems. This versatile tool offers high-quality video and audio streaming, motion detection, cloud integration, and compatibility with various platforms. Users can monitor their surroundings, enhance home security, or keep an eye on loved ones remotely. With user-friendly customization options, this app caters to both beginners and tech-savvy individuals. Whether for security or creative applications, IP Webcam empowers users to make the most of their Android smartphones as live streaming and surveillance devices.

Figure 3.10: IP Webcam

3.6 Summary

Identifying the functional needs of users is paramount. Understanding the specific tasks, objectives, or problems users seek to address through IoT devices lays the groundwork for designing relevant functionalities and features.Users expect IoT devices to seamlessly interact and integrate with other devices and platforms. Compatibility with different protocols and ecosystems enhances the versatility and utility of these devices. Users should have high expectations regarding the reliability and performance of IoT devices.

Chapter 4

Implementation

4.1 Introduction

The implementation phase of the "Smart Door Access Control System with Facial Recognition and Notification" project is pivotal for transforming home security. This phase involves translating the design into a functional system, integrating cutting-edge technologies for seamless operation and user convenience. By focusing on facial recognition and access control, the project aims to revolutionize traditional door access methods, providing a secure, efficient, and user-friendly experience for homeowners.

4.2 Project Design

Flow-Chart of Smart Door System

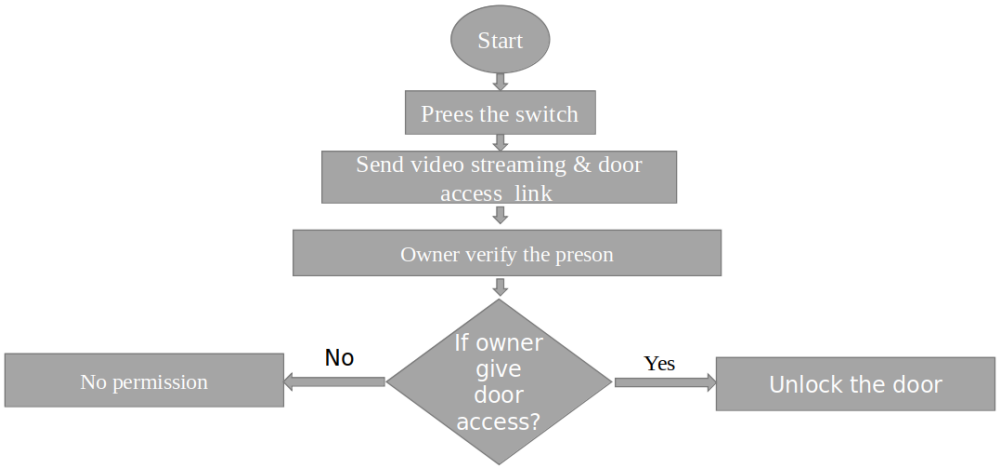

Figure 4.1: Flow-Chart of Smart Door System

System Implementation Design

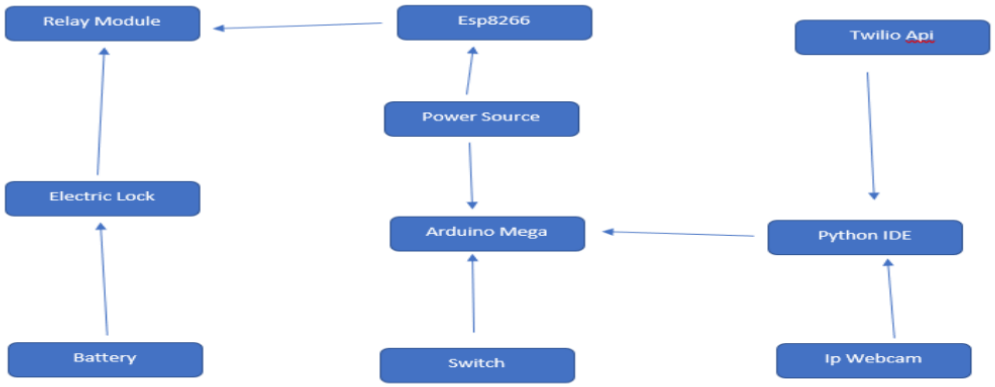

Figure 4.2: System Implementation Design

4.3 Circuit Diagram

Circuit diagrams serve as visual blueprints that convey the structure and connections of an electrical circuit. circuit diagrams are essentially visual representations of electrical circuits, enabling comprehension, design, analysis, and troubleshooting of complex electrical systems.

4.3.1 Schematic Diagram :

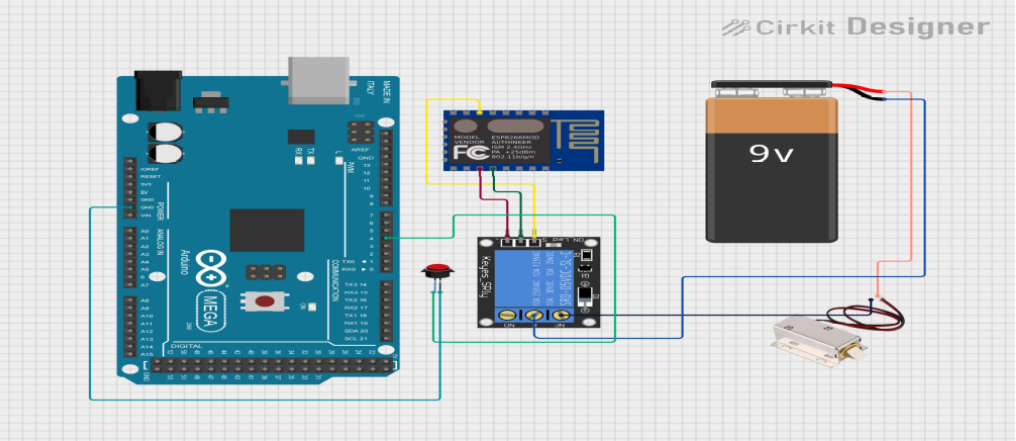

Figure 4.3: Schematic Diagram

4.4 Code Implementation

Code plays a pivotal role in IoT (Internet of Things) projects and is essential for several reasons. Code implements the logic and decision-making processes that enable devices to respond to various conditions, events, or inputs. Code defines how IoT devices function and operate. It determines how devices interact with sensors, actuators, and other components to perform specific tasks or functions.

4.4.1 Source code for ESP 8266

```
#include <ESP8266WiFi.h>

const char* ssid = "Tazul"; // Write your Wi-Fi network's name here
const char* password = "12345678"; // Write your password here
int LOCK = 4; // GPIO4 (D2)
WiFiServer server(80);

void setup() {
  Serial.begin(115200);
  delay(10);
  pinMode(LOCK, OUTPUT);
  digitalWrite(LOCK, LOW);
  // Connect to Wi-Fi network
  Serial.println();
  Serial.println();
  Serial.print("Connecting to ");
  Serial.println(ssid);
  WiFi.begin(ssid, password);
  while (WiFi.status() != WL_CONNECTED) {
    delay(500);
    Serial.print(".");
  }
  Serial.println("");
  Serial.println("Wi-Fi connected");
  // Start the server
  server.begin();
  Serial.println("Server started");
  Serial.println("");
  Serial.println("*Wi-Fi door lock**");

  // Print the IP address
  Serial.print("Use this URL to connect: ");
  Serial.print("http://");
  Serial.print(WiFi.localIP());
  Serial.println("/");
```

```
}

void loop() {
  // Check if a client has connected
  WiFiClient client = server.available();
  if (!client) {
    return;
  }
  // Wait until the client sends some data
  Serial.println("new client");
  while (!client.available()) {
    delay(1);
  }

  // Read the first line of the request
  String request = client.readStringUntil('\r');
  Serial.println(request);
  client.flush();
  // Match the request
  int value = LOW;
  if (request.indexOf("/LOCK=ON") != -1) {
    digitalWrite(LOCK, HIGH);
    value = HIGH;
  }
  if (request.indexOf("/LOCK=OFF") != -1) {
    digitalWrite(LOCK, LOW);
    value = LOW;
  }
  // Return the response
  client.println("HTTP/1.1 200 OK");
  client.println("Content-Type: text/html");
  client.println(""); // do not forget this one
  client.println("<!DOCTYPE HTML>");
  client.println("<html>");
  client.println("<head>");
  client.println("<title>Wi-Fi Door Lock</title>");
  client.println("<style>");
  client.println("body { font-family: Arial, Helvetica, sans-serif;
  text-align: center; background-color: #f2f2f2; }"); // Change the
  background color here
  client.println(".button { background-color: #4CAF50; color: white; padding:
  15px 30px; font-size: 24px; border: none; cursor: pointer; margin: 10px;
  transition: background-color 0.3s ease; }");
  client.println(".button:hover { background-color: #45a049; }");
 client.println(".footer { background-color: #333; color: white;
```

```
 padding: 20px; width: 300px; height: 50px; margin: 0 auto;
  text-align: center; }"); // Footer styles
  client.println(".fst { background-color: #333; color: white;
  padding: 2px; width: auto; height: auto; margin: 0 auto;
  text-align: center; }");
  // here
  client.println(".footer-container { display: flex;
  justify-content: space-between; }");
client.println(".footer { background-color: #333; color: white;
padding: 20px; width: 22%; text-align: center; }"); // Footer styles
  client.println("</style>");
  client.println("</head>");
  client.println("<body>");
  client.println("<img src='https://upload.wikimedia.org/wikipedia
  /commons/4/4e/MBSTU_logo_png.png'  style='width: 50; height: 50;'>");
   // Add your background image here
  client.print("<h1>Door is now: ");
  if (value == HIGH) {
    client.print("Closed</h1>");
  } else {
    client.print("Open</h1>");
  }
  client.println("<br>");
  client.println("<a href=\"/LOCK=ON\"><button class=\"button\"
  onmouseover=\"buttonHover(this)\" onmouseout=\"buttonUnhover(this)\">
  Door Closed</button></a>");
  client.println("<a href=\"/LOCK=OFF\"><button class=\"button\" onmouseover=
  \"buttonHover(this)\" onmouseout=\"buttonUnhover(this)\">Door Open</button>
  </a><br><br>");
  // Footer section
  client.println("<br>");
  client.println("<br>");

  client.println("<div class=\"fst\">");
  client.println("<strong>Developed by:</strong>");
  client.println("</div>");
   client.println("<br>");
client.println("<div class=\"footer-container\">");

// Footer sections
client.println("<div class=\"footer\">");
client.println("NAME: MD. MEHEDI HASAN");
client.println("<br>");
client.println("ID: IT-19034");
client.println("<br>");
```

```
client.println("SESSION: 2018-19");
client.println("<br>");
client.println("</div>");


client.println("<div class=\"footer\">");
client.println("NAME: TAZUL ISLAM");
client.println("<br>");
client.println("ID: IT-19049");
client.println("<br>");
client.println("SESSION: 2018-19");
client.println("<br>");
client.println("</div>");
client.println("</div>");

  client.println("</body>");
  client.println("<script>");
  client.println("function buttonHover(button) { button.style.backgroundColor =
  '#45a049'; }");
  client.println("function buttonUnhover(button) { button.style.backgroundColor =
  '#4CAF50'; }");
  client.println("</script>");
  client.println("</html>");

  delay(1);
  Serial.println("Client disconnected");
  Serial.println("");
}
```

4.4.2 Source code for Arduino Mega

```
const int switchPin = 4; // the pin that the switch is attached to
int switchState = LOW; // variable to store the state of the switch

void setup() {
  // initialize serial communication:
  Serial.begin(9600);
  // initialize the buzzer pin as an output:

  // initialize the switch pin as an input with a pull-up resistor:
  pinMode(switchPin, INPUT_PULLUP);
}

void loop() {
  // read the state of the switch:
```

```
  switchState = digitalRead(switchPin);


  if (switchState == LOW) {

    Serial.println("Switch is ON");


  } else {


    Serial.println("Switch is OFF");
  }
  delay(1000); // Add a small delay to debounce the switch
}
```

4.4.3 Source code for sending message

```
import serial
import time
from twilio.rest import Client

account_sid='AC4900881978e8fe6168bd5fd4a16299f8'
auth_token='fe6d5ab4f3e4928754ccab26966e2bf7'
twilio_number='+12816023615'
target_number='+880 1613 426075'

client = Client(account_sid, auth_token)

msg = client.messages.create(
    body="To watch who is outside: http://192.168.43.1:8080  To unlock the door:
    http://192.168.43.8/",
    from_=twilio_number,
    to=target_number
)


ser = serial.Serial('COM4', 9600)

def send_message():
    while True:
        user_input = ser.readline().decode('utf-8').strip()
        if user_input == "Switch is ON":
            print("Motion detected! Sending message...")
            print(msg.body)
```

```
time.sleep(2)  # wait for the serial connection to initialize

send_message()
```

Chapter 5

PROJECT APPLICATION

5.1 Real Life Application

The "Smart Door Access Control System with Facial Recognition and Notification" project has diverse real-life applications, showcasing its versatility and practical utility:

Home Security Enhancement: The system enhances residential security by offering facial recognition-based access control. It provides homeowners with a convenient and secure way to manage access to their property, ensuring only authorized individuals can enter.

Property Management: In rental properties or shared accommodations, the system can be utilized to manage access for tenants, visitors, and maintenance personnel. It streamlines access control processes and improves overall property security.

Commercial Buildings:

The system is beneficial for securing access to offices, co-working spaces, and commercial establishments. Facial recognition adds an extra layer of security, complementing traditional access control method

Smart Communities:

In gated communities or housing complexes, the system contributes to creating a smart and secure environment. It enables seamless access management for residents and enhances community safety.

Research and Development: Researchers can utilize the project as a platform for developing and testing advanced algorithms, navigation techniques, or sensor fusion strategies. It can serve as a starting point for more complex robotics projects and experiments.

Visitor Management: It can generate real-time notifications to homeowners when visitors arrive, enhancing overall security protocols.

Integration with Smart Homes: It can generate real-time notifications to homeowners when visitors arrive, enhancing overall security protocols.

These are just a few examples of real-life applications for the Smart Drive Robot Car project. The versatility and combination of line following, obstacle avoidance, and Android application control open up possibilities for various industries and personal projects.

Chapter 6

FUTURE SCOPE AND ADVANCEMENTS

6.1 Future scope and advancements

The "Smart Door Access Control System with Facial Recognition and Notification" project presents significant potential for future scope and advancements, paving the way for innovative developments in home security and automation. Here are some potential directions for further enhancement and advancement:

Biometric Integration: Incorporate biometric authentication methods beyond facial recognition, such as fingerprint or voice recognition, to offer diverse and robust access control options.

Integration with AI Assistants: Integrate the system with AI assistants like Amazon Alexa or Google Assistant to enable voice commands for access control and system management, enhancing user convenience.

Enhanced Notification Systems: Implement advanced notification systems that provide detailed activity logs, real-time alerts, and insights into access events, improving monitoring and security management.

IoT Integration: Explore integration with Internet of Things (IoT) devices to create a comprehensive smart home ecosystem. This can include linking door access with lighting, HVAC systems, and security cameras for coordinated automation.

Cloud-Based Storage and Analytics: Utilize cloud-based platforms for data storage, analysis, and remote access. This allows for scalability, data security, and advanced analytics for insights into access patterns and trends.

Enhanced User Interfaces: Develop intuitive and feature-rich user interfaces for mobile apps and web portals, offering enhanced control, customization, and monitoring options for users.

AI-Based Threat Detection: Implement AI algorithms for threat detection, anomaly detection, and predictive analysis to enhance security measures and preempt potential security breaches.

Scalability and Compatibility: Ensure the system's scalability and compatibility with emerging technologies and standards, enabling seamless integration with future smart home devices and platforms.

Energy Efficiency Features: Integrate energy-efficient features such as power-saving modes, automated device scheduling, and energy usage analytics to promote eco-friendly practices within the smart home environment.

These future advancements can propel the Smart Door Access Control System with Facial Recognition and Notification towards becoming a comprehensive and intelligent solution for modern homes, addressing evolving security needs and enhancing user experience and convenience.

Chapter 7

LIMITATION AND CONCLUSION

7.1 Limitations

Despite its capabilities, the "Smart Door Access Control System with Facial Recognition and Notification" project has certain limitations that should be acknowledged:

Environmental Factors: External environmental conditions, such as extreme weather (like heavy rain or fog), may affect the performance of outdoor cameras or sensors, potentially impacting the system's reliability under certain conditions.

Network Dependency: The system relies on network connectivity for real-time notifications and remote access. Any network disruptions or internet outages may temporarily hinder the system's functionality.

Cost and Complexity: Implementing facial recognition and real-time notification features may involve higher costs and technical complexities compared to traditional access control systems. This can be a limitation for budget-constrained or technically inexperienced users.

Privacy and Data Security: Facial recognition systems raise privacy concerns regarding the collection, storage, and use of biometric data. Ensuring compliance with data protection regulations and implementing robust security measures is crucial but can add complexity to the system.

Integration Challenges: Integrating the system with existing security infrastructure or legacy systems may pose integration challenges or require additional customization, depending on the compatibility and protocols involved.

User Training and Adoption: Users may require training or familiarization with the system's features and operation, especially concerning facial registration and access control procedures. User adoption and acceptance can be influenced by the system's ease of use and perceived benefits.

7.2 Conclusion

In conclusion, the "Smart Door Access Control System with Facial Recognition and Notification" project presents a significant advancement in home security technology. By

combining facial recognition, real-time notification alerts, and remote access control through a mobile application, the system offers a comprehensive solution for modern security needs.

While the project showcases innovative features and functionalities, it is important to acknowledge certain limitations and areas for future development. These may include refining the accuracy of facial recognition algorithms under varying conditions, ensuring robustness against environmental factors, enhancing network resilience, addressing cost considerations, and strengthening data privacy and security measures.

Looking ahead, the future scope of the project can involve integrating advanced AI and machine learning techniques to improve facial recognition accuracy and response times. Enhanced compatibility with diverse hardware and software platforms, as well as seamless integration with existing home automation systems, can further elevate the system's usability and convenience.

Furthermore, ongoing research and development can focus on expanding the system's capabilities to encompass additional smart features, such as voice recognition, gesture control, or integration with IoT devices for broader home automation functionalities.

Overall, the "Smart Door Access Control System with Facial Recognition and Notification" project lays a solid foundation for smart and secure home access control. By addressing current limitations and embracing future advancements, the project is poised to contribute significantly to the evolution of home security systems, offering enhanced convenience, efficiency, and peace of mind for users.

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